

## Estimating the effects of excess nutrients on stream invertebrates from observational data

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**Abstract.** Increased nutrient concentrations in streams and rivers have altered biological structure and function. Manipulative studies have provided insights into different mechanisms by which changes in nutrient concentrations influence aquatic biota, but these studies are limited in spatial scope and in their quantification of nutrient effects on aggregate measures of the invertebrate assemblage. Observational data provide a complementary source of information to manipulative studies, but these data must be analyzed such that the potential effects of spurious correlations are minimized. Propensity scores, a technique developed to analyze human health observational data, are applied here to estimate the effects of increased nutrients on the total taxon richness of stream invertebrates in a large observational data set collected from the western United States. The analysis indicates that increases in nutrient concentration are strongly associated with and cause decreases in invertebrate richness in large, but wadeable, open-canopied streams. These decreases in invertebrate richness were not mediated by periphyton biomass, a commonly proposed mechanism by which nutrients influence invertebrates. In smaller, closed-canopied streams, increases in nutrients were associated with small increases in total richness that were not statistically significant. Using propensity scores can greatly improve the accuracy of insights drawn from observational data by minimizing the potential that factors other than the factor of interest may confound the results.

**Key words:** confounding variables; macroinvertebrate; nitrogen; nutrients; phosphorus; propensity scores; streams; total taxon richness.